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VLBI of GLAST targets at far south declinations

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Southern Hemisphere VLBI capabilities

■ Telescopes:

- Australia (6 + 3 new in 2008/09);
- New Zealand (1 new in 2008);
- South Africa (1);
- Possible to co-observe with China, Japan, USA: good for equatorial and near south targets;

7 antenna Southern Hemisphere array (11 in 2008/09)

■ Recording systems

- LBADR (based on PCEVN system, up to 1 Gbps);
- Mark5 (in 2008/09);

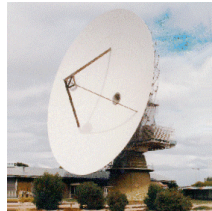
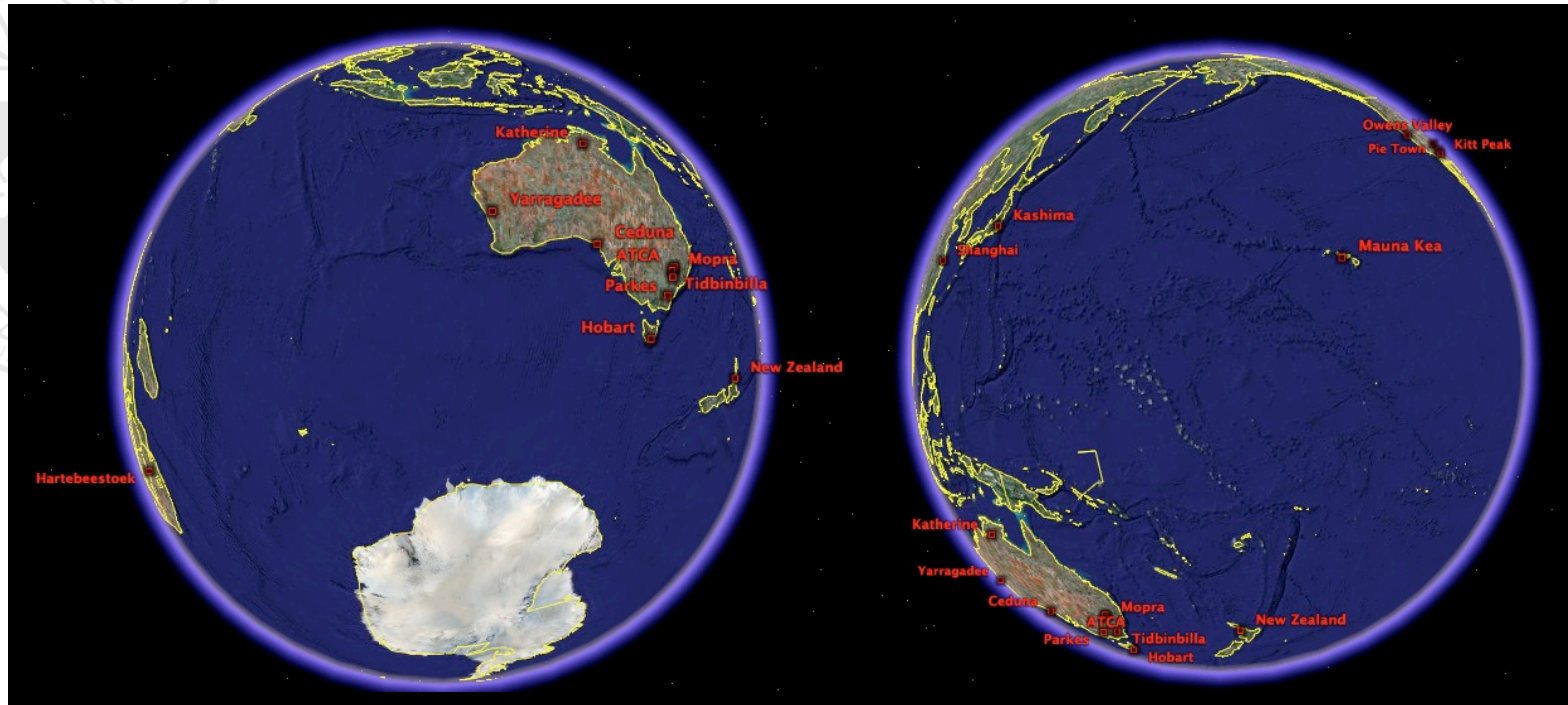
■ Correlator

- Software correlator on Swinburne supercomputer (~1000 core Beowulf cluster);
- Supports LBADR, Mark5, K5 etc formats i.e. mixed array compatibility

■ e-VLBI

- Real-time fibre optic links between 4 telescopes in Australia and Swinburne supercomputer;
- Rapid response observations for transient sources;

Antenna locations



Frequency bands, antenna parameters

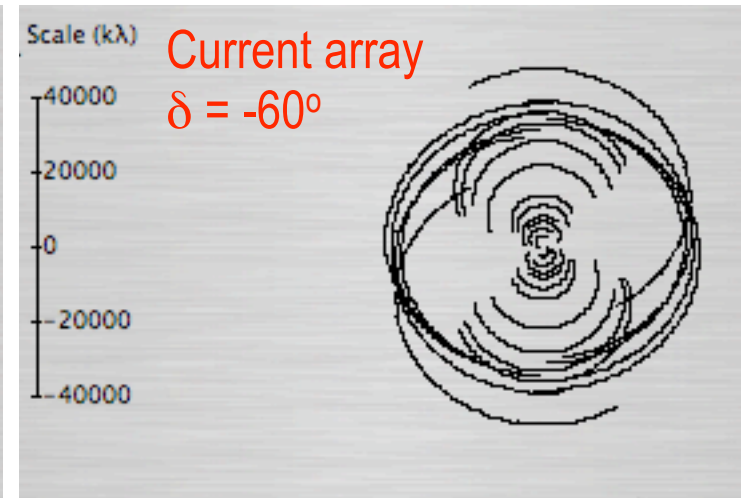
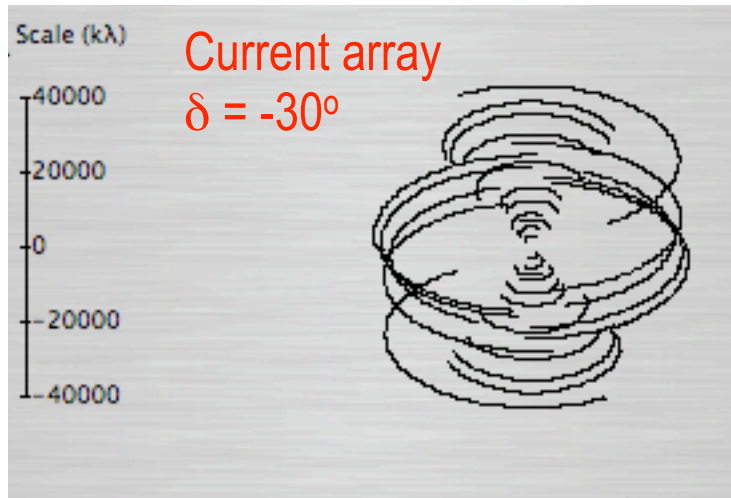


| <u>Telescope</u> | <u>Organisation</u> | <u>Diameter</u> | <u>8.4 GHz Tsys</u> |
|------------------|---------------------|-----------------|---------------------|
| ATCA | ATNF | 6 x 22 m | 80 Jy |
| Parkes | ATNF | 64 m | 40 Jy |
| Mopra | ATNF | 22 m | 400 Jy |
| Tidbinbilla* | NASA | 70 m | 25 Jy |
| Hobart | U.Tas. | 26 m | 550 Jy |
| Ceduna^ | U.Tas. | 30 m | 600 Jy |
| Hartebeesthoek | Hart.RAO | 26 m | 340 Jy |

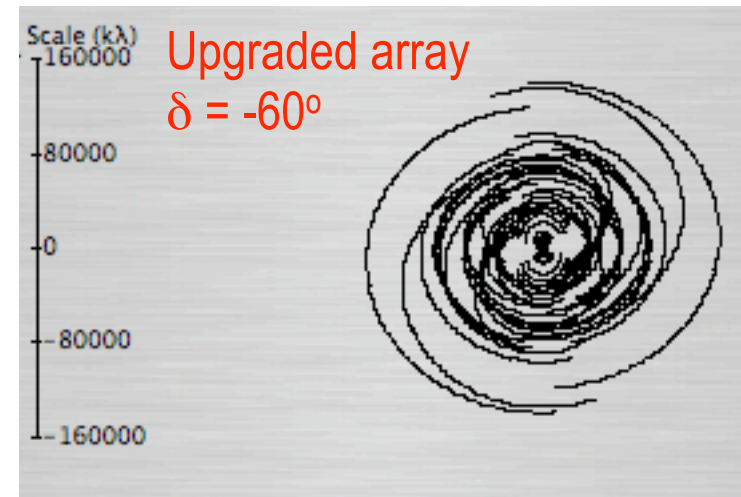
* No 5.0 GHz receiver

^ No 1.4 or 1.6 GHz receiver

(u,v) coverage and sensitivity



- 8.4 GHz;
- 12 hour (10% on phase calibrator);



(u,v) coverage and sensitivity (cont.)



- 12 hours observation (phase referenced);
- Max data rate (512 Mbps at 3 antennas; 1 Gbps at 3);
- 8.4 GHz;
- Uniform weighting;

⇒ ~60 uJy/beam (1 σ image RMS);

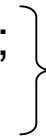
⇒ ~4 mas FWHM beam;



Current Australian array

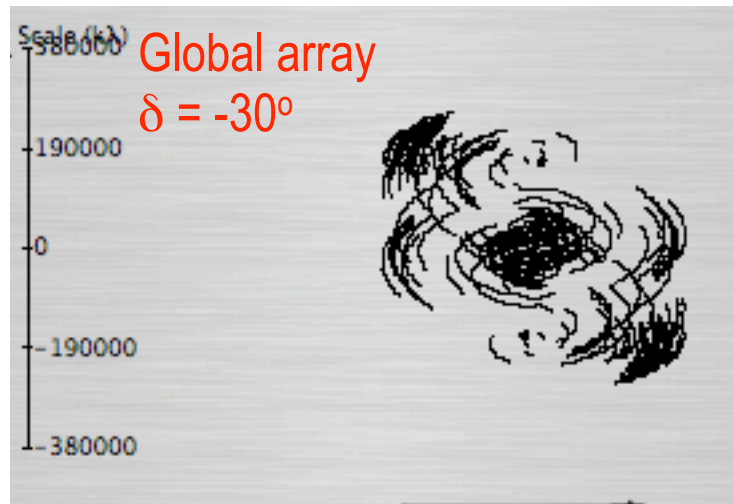
⇒ ~140 uJy/beam (1 σ image RMS);

⇒ ~1 mas FWHM beam;



Upgraded Australian +
New Zealand array
(4 new antennas)

(u,v) coverage and sensitivity (cont.)



Same parameters as previous slide:

⇒ ~60 uJy/beam;

⇒ ~0.4 mas FWHM beam.

Australia

New Zealand

South Africa

Japan (Kashima)

USA (VLBA)

Southern Hemisphere VLBI array will be co-observing with the VSOP-2 space VLBI mission, following on from VSOP investigation of EGRET sources.

e-VLBI capabilities and wide-field imaging

- e-VLBI is realtime VLBI:

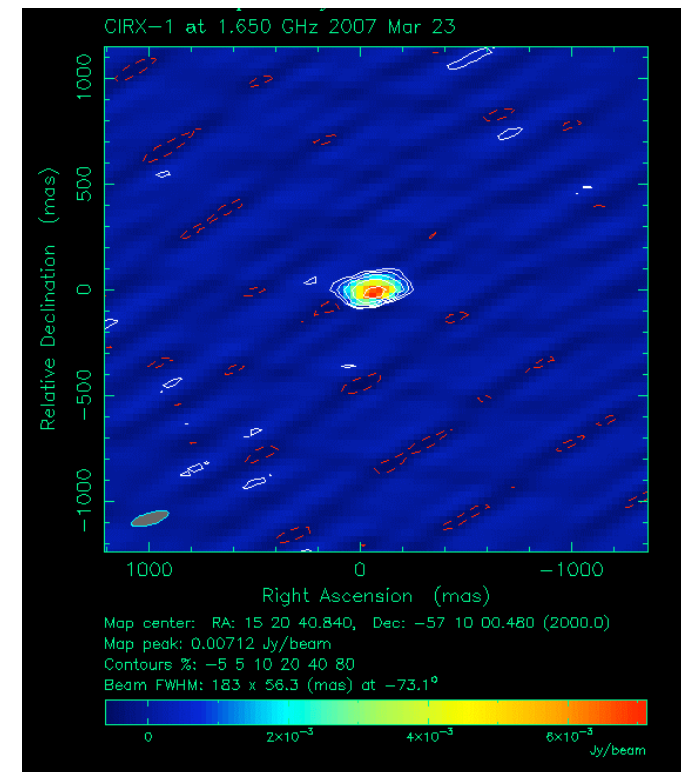
- ☐ Data transport over long haul fibre to correlator;
- ☐ Realtime correlation;

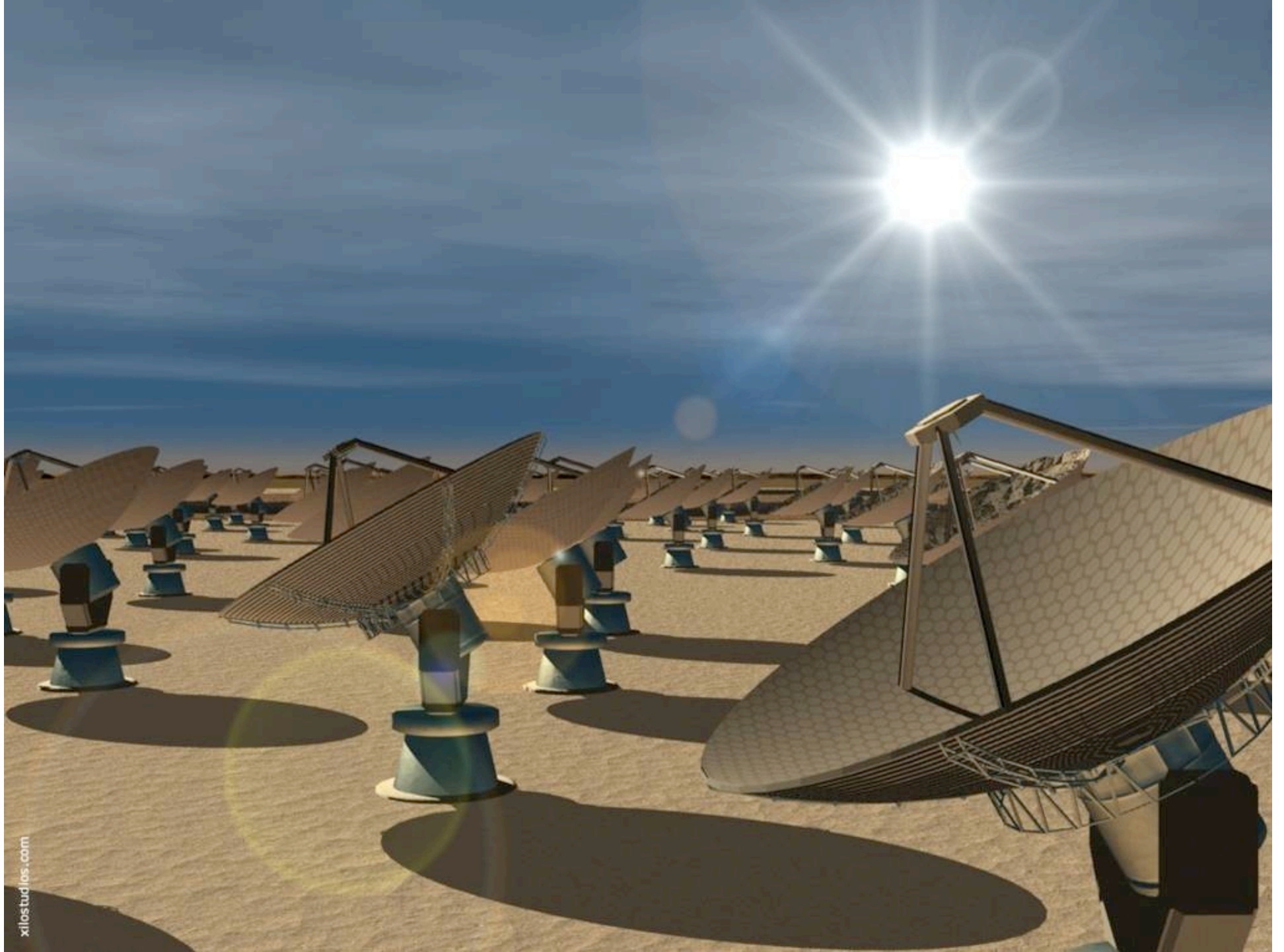
- Benefits:

- ☐ Rapid response to transient radio sources;
 - ☐ Aim is within 1 hr of receiving trigger;
- ☐ Instant feedback on detection;

- Applications:

- ☐ X-ray binaries;
- ☐ GRBs (require wide-field imaging capabilities or simultaneous low resolution observations - can use ATCA in parallel with e-VLBI);







Relevance for GLAST

- Access to Southern Hemisphere targets $\delta < -40^\circ$;
- Improved (u,v) coverage for targets $-40^\circ < \delta < +10^\circ$;
- e-VLBI + wide-field imaging capability for GRBs and other transients;
- Possibility of supporting observations with the ATCA for flux density monitoring of AGN and GRB followup;
- Pulsars, X-ray binaries, supernovae in nearby starburst galaxies etc;
- A good track record with EGRET, surveys, monitoring:
 - Large-scale ICRF VLBI monitoring (Ojha et al.);
 - VLBI and space VLBI studies of EGRET and differences between gamma-ray loud/gamma-ray quiet AGN (Tingay et al.)
 - ATCA flux density monitoring in support of VSOP, with application to EGRET (Tingay et al. 2002);
 - Flux density monitoring programs for IDV (Jauncey/Lovell et al.)

Practicalities



- Peer review proposal process managed through ATNF Time Assignment Committee:
 - PROPOSAL DEADLINES: June 15 and December 15 for 6 month observing semesters (<http://www.atnf.csiro.au/observers>);
 - More details at <http://www.atnf.csiro.au/vlbi>;
 - Coordination required for global VLBI observations;

- Observing sessions of 1 - 2 weeks duration, 3 or 4 times per year.
 - Involvement of the proposal team required during observations
 - Not as friendly as the VLBA or EVN - some local knowledge is a benefit!!

- Anyone interested in joining a large Southern Hemisphere VLBI proposal to support GLAST? Also, flux density monitoring with the ATCA?